



INTEROFFICE CORRESPONDENCE

DATE: January 19, 1996

TO: Distribution
[Signature]

FROM: Rick Roberts, Remediation Technical Support, T893B, X4869

SUBJECT: DRAFT REGULATORY REVIEW OF RADIONUCLIDE REMEDIATION
REQUIREMENTS RSR-001-96

ACTION: Review attached regulatory review and submit comments

Attached is the Draft Regulatory Review of Radiation Dose Based Remediation Requirements For Environmental Media Contaminated With Radionuclides for your review and comment. Please submit any comments to me by January 30.

If you have any questions, please call me at extension 4869.

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**DRAFT
REGULATORY REVIEW OF
RADIATION DOSE BASED REMEDIATION REQUIREMENTS
FOR
ENVIRONMENTAL MEDIA CONTAMINATED WITH RADIONUCLIDES**

DRAFT REGULATORY REVIEW OF
REMEDICATION REQUIREMENTS
FOR RADIONUCLIDES

INTRODUCTION

In order for remediation activities to proceed, Final Remediation Goals (FRG) must be developed for a site or operable unit. FRGs are site-specific concentrations of radionuclides, metals or chemicals in one or more environmental media that are not detrimental to human health or the environment. FRGs are either based on an Applicable or Relevant and Appropriate Requirement (ARAR) or on risk assessment. ARARs are usually based on state or federal regulations. Risk assessments are developed for a site through the Remedial Investigation (RI) Report or the RCRA Facility Investigation (RFI) Report. The following discusses the determination of an FRG for radionuclides only.

BACKGROUND

Initially, a determination must be made on the use of an ARAR or a risk assessment as the basis for developing FRGs. For remediation activities, it has been determined that an ARAR based criteria takes precedence over a risk based criteria. This is shown in technical memorandum #2 for the Feasibility Study (FS) at Operable Unit 2 (OU2) (DOE, 1995c). In this technical memorandum, Preliminary Remediation Goals (PRG) based on ARARs were used preferentially over risk based PRGs. This determination is seen in the following Corrective/Remedial Action Objectives (C/RAO) for surface and subsurface soils in the technical memorandum. (Comments from the Department of Energy (DOE), the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and the Environment (CDPHE) have been incorporated into these C/RAOs.)

- * Remediate contaminated surface and subsurface soils to non-zero chemical-specific ARARs or to-be-considered (TBC) values, as appropriate.
- * In the absence of ARARs/TBCs, remediate contaminated surface and subsurface soils so that they are within an acceptable risk range (excess cancer risk greater than 10^{-4} to 10^{-6} or a hazard index of greater than one for non-carcinogens) considering the reasonable maximum exposure scenario.

Similar C/RAOs are defined for groundwater remediation in technical memorandum #2. This clearly shows that ARARs based remediation goals are preferential to risk based remediation goals.

ARARs/TBCs APPLICABLE IN CERCLA PROGRAM

For the OU2 FS, potential ARARs and TBC criteria for radionuclides were reviewed for use. DOE Order 5400.5 was considered a TBC. No ARARs for radionuclides were designated for use in the OU2 FS. The basis for designating DOE Order 5400.5 as a TBC criteria can be found in technical memorandum #1 for the OU2 FS (DOE, 1995a). This technical memorandum states that "The Atomic Energy Act (AEA) grants DOE authority over AEA-regulated radionuclides. Pursuant to

this authority, the DOE has established radiation protection standards for offsite members of the public under Radiation Protection of the Public and the Environment, DOE Order 5400.5 ...To ensure that the offsite radiation dose is maintained at acceptable levels, the DOE has developed an annual radiation dose limit of 100 millirem effective dose equivalent to members of the public. The provisions of DOE Order 5400.5 are currently in the process of being promulgated as 10CFR834. The annual radiation dose limit of 100 millirem effective dose equivalent is considered a TBC until promulgation of 10CFR834, at which time the annual radiation dose limit will be identified as an ARAR." This expressly states that DOE Order 5400.5 is a current TBC criteria with 10CFR834 being an ARAR when it is promulgated. EPA and Nuclear Regulatory Commission (NRC) standards are not considered to be TBCs or ARARs.

With respect to NRC standards, the DOE has stated that NRC standards are not ARARs or TBCs unless the NRC standard covers an area that is not covered by a DOE Order (DOE, 1995b). This reference states "It is DOE's understanding that EPA and the State believe that NRC standards should be considered relevant and appropriate, regardless of whether a DOE Order exists which covers the same area as a NRC standard. The DOE disagrees because even though NRC regulations may be relevant, they are inappropriate because a DOE site is exempt from NRC regulations. The exemption and type of facility regulated are factors in determining when a regulation is inappropriate. A requirement (NRC regulation) may also be found relevant but not appropriate when another requirement (DOE Orders) is available that has been designed to apply to that specific situation. (See CERCLA Compliance with Other Laws Manual, EPA/540/G-89/006, p.1-67.) Moreover, DOE will not list NRC standards as either a potential ARAR or a TBC in its technical memorandums or feasibility studies unless the NRC standard covers an area not addressed by a DOE Order."

PROPOSED RADIATION DOSE STANDARDS FOR SITE REMEDIATION

The following radiation dose standards may apply to the remediation of radionuclides in the environment at DOE and/or other sites remediating radioactive materials. These standards were evaluated so that the potential impact of current as well as proposed standards could be assessed.

- * DOE Order 5400.5, "Radiation Protection of the Public and the Environment." This is a current DOE regulation.
- * Proposed Title 10 of the Code of Federal Regulations, Part 834, "Radiation Protection of the Public and the Environment," revised August 25, 1995 (Proposed 10CFR834). This is a proposed DOE Regulation.
- * Proposed Title 40 of the Code of Federal Regulations, Part 196, "Radiation Site Cleanup Regulations," dated October 21, 1993 (Proposed 40CFR196). This is an EPA Advanced Notice of Proposed Rulemaking.

- * Proposed Title 10 of the Code of Federal Regulations, Parts 20, 30, 40, 50, 51, 70 & 72, "Radiological Criteria for Decommissioning," dated August 22, 1994 (Proposed 10CFR-NRC). This is a proposed Nuclear Regulatory Commission Regulation.

DOE ORDER 5400.5

The 100 millirem annual radiation dose limit was adopted by the DOE in DOE Order 5400.5 because of the recommendations of the ICRP as outlined in ICRP Publication 26. This publication recommended a system of dose limitations that has been adopted and implemented by essentially all countries with nuclear programs. These recommendations combine a radiation dose limit with the application of the As Low As Reasonably Achievable (ALARA) philosophy. The primary dose limit for members of the public from this publication is also 100 millirem in a year. This dose limit represents a risk of 10^{-5} to 10^{-6} per year.

Section IV.4.a, "Residual Radionuclides in Soil" of DOE Order 5400.5 applies to the remediation of soils. This section states that, "Guidelines for residual concentrations of ...radionuclides shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901." This section states that an environmental pathway analysis per DOE/CH-8901 must be used to derive acceptable levels of radionuclides in the environment. DOE/CH-8901 has been revised as ANL/EAD/LD-2, "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0," dated September, 1993. This manual outlines the correct procedures for implementing DOE Order 5400.5 using the RESRAD computer code.

With respect to implementing the radiation dose limit requirement within DOE Order 5400.5, ANL/EAD/LD-2 states "Consistent with the recommendations of the International Commission on Radiological Protection (ICRP) regarding the establishment of dose constraints, that are lower than the 100 mrem in a year dose limit, DOE recommends that 30 mrem in a year be generally applied as a constraint for dose to any individual under the actual use or likely future use scenarios. That is, remedial measures selected through the ALARA process must be sufficiently protective to ensure that likely potential doses will be less than 30 mrem from a year of exposure." This passage shows that DOE is supportive of the ALARA philosophy through implementing a radiation dose limit of 30 millirem which is below the 100 millirem annual radiation dose standard promulgated in DOE Order 5400.5. Additionally, an ALARA analysis should be applied so that radiation dose is minimized below the 30 millirem dose limit.

Concerning the environmental pathway analysis within DOE Order 5400.5, ANL/EAD/LD-2 states "The radiation dose is defined here as the effective dose equivalent (EDE) from external radiation plus the committed effective dose equivalent from internal radiation...The critical population group is a relatively small, homogeneous group that is representative of those individuals in the population expected to potentially receive the largest radiation dose. An example of the critical population group

is a family that establishes residence on a site after the site has been released for use without radiological restrictions. Other examples of the critical population group include industrial workers and recreationists." This shows that a number of different exposure scenarios may be used to support compliance with the 30 millirem annual dose limit. The text goes on to say "As noted, the final authorized limits should be based on a realistic assessment of future use of the subject property, but they should be sufficiently protective to ensure that the other less likely but plausible use scenarios will not cause potential doses to exceed 100 millirem in a year. The worst-case use scenario is typically the family-farm scenario. When this scenario is not realistic but is plausible, it can generally be assumed to be the most restrictive use and therefore may be used to demonstrate that the potential uses for all plausible scenarios will not exceed the 100 millirem in a year dose limit. In cases where the family-farm scenario is the likely future use, the 30 mrem in a year constraint should be used in developing the guideline values." The Rocky Flats Future Site Use Working Group future land use recommendations and ASAP have delineated the likely and plausible future uses of the Rocky Flats Plant. These uses are industrial within the industrialized area of the plant and recreational in the buffer zone. It is not believed that the residential exposure scenario is considered a plausible future land use at Rocky Flats.

PROPOSED 10CFR834

Proposed 10CFR834 states that the 100 millirem primary radiation dose standard should be used for members of the public. This simply reiterates the dose limits in DOE Order 5400.5. In Subpart G, "Radiological Protection Requirements in the Management of Property Containing Residual Radioactive Material," of 10CFR834, there is a requirement that Authorized Limits shall not be exceeded for residual radioactive material and that the ALARA process will be used to derive authorized limits. Residual radioactive material in soil is assessed in Part 834.302, "Soil," which states that "Authorized limits and Supplemental Limits for all radionuclides in soil shall be derived using approved models in accordance with the requirements of this subpart and selected on the basis of the ALARA process."

Implementing the ALARA process at a site is not straight forward. To get an idea of DOE's position on implementing the ALARA philosophy, the comment response section of the proposed regulation must be examined. One commenter asked for clarification concerning the dose limit to be used with property that has residual radioactive material. The response to this comment was, "The primary dose limit for members of the public is 100 mrem in a year from all sources and pathways. Released material represents only one source of exposure. The authorized and supplemental dose limits, therefore, would be within the primary dose limit for the public and we anticipate that they will be a small fraction, probably less than 1/4 of the primary (100 mrem/y) dose limit, through the required application of the ALARA process. The actual fraction would vary with the details of the evaluation and the material released and would vary from application to application." This is interpreted to mean that DOE believes that the upper bound to an ALARA analysis will be a 25 millirem annual radiation dose.

DOE's position on model use for deriving the authorized limits is again seen in the comment response section of the proposed regulation. A question on this subject is answered "Requirements for obtaining authorized limits and supplementary limits are presented in paragraph 834.301. Among the requirements are estimates of potential doses to individuals and collective doses from exposure pathways (paragraph 834.102) evaluated by using analytical models which have been approved by DOE, e.g., RESRAD, and estimating costs of alternative procedures to provide data for ALARA determinations (paragraph 834.104)." This shows that DOE believes that the RESRAD methodology should still be followed to show compliance with 10CFR834.

With respect to exposure scenarios, the text of 10CFR834 states that the actual and likely use scenario and the worst plausible use scenario shall be evaluated. Interpretation of this requirement is found in the comment response section of proposed 10CFR834 which states that "The 'actual and likely' use scenario is to be the basis for the ALARA analysis. Such an approach is not inconsistent with EPA guidance. Many actions and EPA's records of decision (RODs) are based on EPA's best estimates of expected land use that were derived from an assessment of past and expected future activities at the sites. This concept is consistent with the comments received at the November 19, 1991, 'Intergovernmental Public Meeting on Risk Assessment in the Federal Government: Asking the Right Questions' at which '...commenters were virtually unanimous in their support for a movement away from worst-case analysis toward more realistic and plausible exposure assessments.' This concept is also consistent with recent administration proposals relating to CERCLA authorization regarding the considerations used for land use when selecting a remedy. These include land use history, current land use, zoning and future land use plans. The 'actual and likely' use scenario definition is intended to address these considerations and will be coordinated through the site advisory boards and the NEPA process public meetings. The requirement to evaluate the worst plausible use is only a secondary check to ensure that application of the likely use scenario does not overlook an extremely hazardous situation or a very susceptible subgroup." Again, the Rocky Flats Future Site Use Working Group and ASAP have delineated the likely and plausible future uses of the Rocky Flats Plant. These uses are industrial within the industrialized area of the plant and recreational in the buffer zone. It is not believed that the residential exposure scenario is considered a plausible future land use at Rocky Flats.

PROPOSED 40CFR196

In section IV, "Policy and Technical Rationale For Proposed Regulatory Approach," Proposed 40CFR196 states "EPA is proposing a cleanup standard of 15 mrem/yr to guide cleanup activities at sites contaminated with radioactive material and to allow either unrestricted use of those sites or alternate uses coupled with active control measures following cleanup. This cleanup standard corresponds to an excess lifetime cancer incidence risk of 3×10^{-4} ." EPA believes that this radiation dose level is appropriate for the remediation of sites contaminated with radioactive material due to an extensive regulatory review. Section IV states "In order to determine the acceptable level of risk, EPA examined the risk levels that were considered protective in other governmental actions,

particularly actions performed by EPA in other radiation-control programs. The Agency also reviewed the precedents set in regulations, guidances, and site-specific cleanup decisions." Therefore, an extensive review of current practices was performed to support the 15 millirem dose standard.

The 15 millirem annual dose standard actually applies to unrestricted release exposure scenarios. If remediation is targeted for other than unrestricted release, EPA is requiring that a second radiation dose be evaluated. 40CFR196 states "EPA is proposing that in the absence of active or effective institutional controls, members of the public do not receive doses in excess of 75 mrem/yr in excess of natural background levels. In other words, members of the public would not receive doses in excess of this limit even if all of the controls at a site fail." This means that an unrestricted use scenario needs to be evaluated with failure of all remediation alternatives. The annual radiation dose to this scenario cannot exceed 75 millirem.

Concerning the derivation of the 75 mrem/yr limit, EPA states "Although a committed effective dose of 75 mrem/yr corresponds to a lifetime excess cancer risk of 1.4×10^{-3} , this level is consistent with the ICRP recommendations of an overall dose limit from man-made radiation of less than 100 mrem. The 75 mrem/yr figure, accounts for the possibility that there might be another source of man-made radiation, in the vicinity of the site. EPA derived the 75 mrem figure by subtracting from 100 mrem, 25 mrem allowed by the Uranium Fuel Cycle rule, which is the highest dose allowed from a single source. EPA considered it extremely unlikely that there would be several sources of man-made radiation within the vicinity of a single site. (New paragraph) Also, EPA did not want to choose a number that was so low that it would in effect require a site to either be cleaned up to a level that allowed it to be released for residential use or not to be released at all. This may occur because permitting a site to be released for industrial/commercial use allows the implementing agency to leave a higher radionuclide concentration than if the site were to be released for residential use. This is because an industrial/commercial exposure scenario generally has fewer exposure pathways than a residential scenario. The 75 mrem/yr dose has been chosen as an appropriate balance between protecting the public should institutional controls fail, and imposing additional standards in those cases when institutional controls have been determined to be appropriate at a given site."

EPA also requires that a time frame of 1,000 years be assessed. This requirement came from the fact that many sites contain radionuclides with very long half-lives. "In sum, EPA is proposing an intergenerational time frame of 1,000 years as the assessment period for cleanup activities to ensure that the creation of decay products and the long-term integrity of active control measures is adequately considered."

PROPOSED 10CFR-NRC

Concerning the radiation dose limit for decommissioning, the proposed regulation states "The limit for release of a site is 15 mrem/y (0.15mSv/y) TEDE for residual radioactivity distinguishable from background. If doses from residual radioactivity are less than 15 mrem/y TEDE, the Commission will

terminate the license and authorize release of the site for unrestricted use following the licensee's demonstration that the residual radioactivity at the site is ALARA." The NRC radiation dose limit also applies to an unrestricted release exposure scenario over a 1,000 year timeframe.

With respect to releasing a site with institutional controls, the proposed rule states "Licensees unable to meet the requirements for unrestricted use would be allowed to request permission to release sites for restricted use with subsequent termination of the license if they can demonstrate that...Residual radioactivity at the site has been reduced so that if the site were released for unrestricted use, the TEDE from residual radioactivity to the average member of the critical group is as low as reasonably achievable and would not reasonably be expected to exceed 100 mrem (1 mSv) per year." Therefore, a residential exposure scenario would need to be assessed per the NRC requirements if institutional controls are part of a site remediation.

The proposed NRC requirements state that an ALARA analysis needs to be performed. The text goes a step further though and says "For purposes of determining when further ALARA efforts need not be further analyzed and documented, the Commission would consider that the ALARA requirement has been met if the TEDE to the average member of the critical group from all radionuclides that could contribute to residual radioactivity and are distinguishable from background does not exceed 3 mrem (0.03 mSv) per year."

PATH FORWARD

Since DOE Order 5400.5 is the only regulation considered to be a TBC under CERCLA and is currently promulgated, it is reasonable to use this as the path forward. The primary radiation dose criteria would therefore be 30 millirem/year with the application of an ALARA analysis. This requirement is found in the RESRAD manual. The exposure scenarios to be used would be those recommended by the Rocky Flats Future Site Use Working Group and ASAP.

Since 10CFR834 will replace DOE Order 5400.5 and will be considered an ARAR under CERCLA, it would be prudent to incorporate these requirements into any path forward. It is believed that the requirements within 10CFR834 are encompassed in the implementation of DOE Order 5400.5. An added insight into the radiation dose level that DOE feels is ALARA can be found in the comment responses to 10CFR834. It is stated here that the result of the ALARA analysis should not exceed a radiation dose level of 25 millirem/yr.

DOE believes that EPA and NRC standards should not currently be used for remediation activities at DOE sites. This fact is seen in the final rule overview to 10CFR834 which states that "The Department is aware of, and is supporting, EPA and NRC efforts to establish specific standards for residual radioactive material. The NRC has published a proposed rule and the EPA has issued a pre-proposal draft of its standard. We expected both agencies to issue final standards within the next two years. In the interim, the Department will continue to use the table of surface contamination limits

contained in the Order DOE 5400.5 and associated guidance documents for the release of property containing residual radioactive material for unrestricted use and will continue to implement its ALARA-based system for regulating releases on a case-specific basis. While the Department's process is different from the draft standards distributed by EPA and NRC, Departmental reviews of the results of cleanups conducted using the Department's process indicate that such remedial actions are equally protective. In any case, once EPA issues generally applicable standards (40 CFR Part 196) the Department will consider modifying 10 CFR Part 834 to be consistent with the EPA requirements or to directly adopt the EPA standard." Therefore, EPA and NRC standards will be incorporated into the path forward to the extent practicable.

An annual radiation dose limit of 15 millirem has been selected as the path forward. This radiation dose is consistent with the primary dose limit from 40CFR196 and 10CFR-NRC. Furthermore, a qualitative ALARA analysis was performed by taking a fraction (50%) of the 30 millirem annual dose limit as the path forward. Also, this radiation dose limit is 60% of the 25 millirem/yr which is the upper bound radiation dose from an ALARA analysis. Due to the requirements found in DOE Order 5400.5 and 10CFR834, the 15 millirem/yr limit will be used with an industrial exposure scenario and a recreational exposure scenario in the industrial area and buffer zone of the Rocky Flats Plant, respectively.

REFERENCES

- DOE, 1995a Technical Memorandum No. 1, Development of Corrective/Remedial Action Objectives for Operable Unit No. 2; U.S. Department of Energy, Rocky Flats Environmental Technology Site, Golden, CO; Final, Revision 2, January, 1995.
- DOE, 1995b Letter 95-DOE-08311, DOE's resolutions to issues within the ARARs Working Group, from Steven W. Slaten (DOE IAG Project Coordinator) to Martin Hestmark (EPA Rocky Flats Project Manager) and Joe Schieffelin (CDPHE Hazardous Waste Facilities Unit Leader), dated April 25, 1995.
- DOE, 1995c Technical Memorandum No. 2, Initial Screening of Remedial Technologies and Identification Of Remedial Alternatives for Operable Unit No. 2; U.S. Department of Energy, Rocky Flats Environmental Technology Site, Golden, CO; Revision 0, May, 1995.